

**STATE OF VERMONT  
PUBLIC SERVICE BOARD**

Amended Petition of Entergy Nuclear Vermont Yankee, LLC, and )  
Entergy Nuclear Operations Inc., for amendment of their Certificate )  
of Public Good and other approvals required under 30 V.S.A. )  
§ 231(a) for authority to continue after March 21, 2012, operation of )  
the Vermont Yankee Nuclear Power Station, including the )  
storage of spent nuclear fuel )

Docket No. 7862

DIRECT TESTIMONY OF BRUCE E. HINKLEY  
ON BEHALF OF THE  
VERMONT DEPARTMENT OF PUBLIC SERVICE

October 22, 2012

Summary: Mr. Hinkley addresses post-Fukushima requirements and local plant operational history at the Vermont Yankee Nuclear Power Station (the “VY Station”) as well as certain logistical and procedural hurdles related to those issues as they may affect the environmental, economic, land use, and aesthetic impacts of continued operation and eventual decommissioning of the plant.

Mr. Hinkley sponsors the following exhibits:

Exhibit PSD-BH-01	Resume of Bruce E. Hinkley
Exhibit PSD-BH-02	Blue Ribbon Commission on America’s Nuclear Future, Report to the Secretary of Energy (January 2012)
Exhibit PSD-BH-03	Entergy VY’s Response to Windham Regional Commission’s Second Set of Information Requests, A.WRC:EN.2-12 (Oct. 3, 2012)

1 Q1. Please introduce yourself and provide your business name and address.

2 A1. My name is Bruce E. Hinkley. I am the Vice President, Commercial Division of TCPS,  
3 LLC ("TCPS"). My business address is 130 Mitchell Road, Oak Ridge, TN 37830.

4  
5 Q2. Please describe your educational and professional background.

6 A2. I received a Bachelor of Science in Analytical Management from the United States Naval  
7 Academy in 1976 and completed graduate level nuclear engineering courses in 1977 as  
8 part of my training in the U.S. Navy Nuclear Training Program. I received my  
9 certification as a U.S. Navy Chief Engineer – Nuclear Submarines in 1979. I am a  
10 member of the American Nuclear Society.

11 I have over 35 years of nuclear experience in engineering, construction, and  
12 operations. I have performed over 30 technical and management level reviews of nuclear  
13 facilities and systems in the United States, Canada, South Africa, and the Philippines. I  
14 have also provided executive consulting services on a wide range of nuclear projects to  
15 the U.S. Department of Energy since 2003. Similar projects that I have been involved  
16 with are: Brunswick Nuclear Plants 1 & 2 Improvement Plan & Restart, Maine Yankee  
17 Independent Safety Assessment & Restart, and Dresden Nuclear Station Independent  
18 Safety Assessment. My experience focuses on nuclear conduct of operations, licensing  
19 and regulatory compliance, engineering design, nuclear safety, risk management, and  
20 quality programs. My resume is included as Exhibit PSD-BH-01.

21 My current company, TCPS, is an engineering nuclear technical support  
22 consulting firm with offices in Oak Ridge, TN and North Augusta, SC. TCPS provides a  
23 variety of services to the nuclear utility industry and government agencies including

1 performance improvement plan development, corrective action program assessments,  
2 causal analysis, licensing and regulatory services, independent process and program  
3 reviews, independent design reviews, nuclear safety oversight, risk management,  
4 operational readiness reviews, and executive mentoring and training services. Nuclear  
5 plant support services provided by TCPS also include expert testimony on matters  
6 relating to plant management, construction, licensing, and performance issues in  
7 technical litigation and regulatory proceedings.  
8

9 Q3. On whose behalf are you testifying?

10 A3. I am testifying on behalf of the Vermont Department of Public Service ("PSD").  
11

12 Q4. What is the purpose of your testimony?

13 A4. My testimony will address (1) the operational history of the Vermont Yankee Nuclear  
14 Power Station (the "VY Station"), with which I am familiar because of my work on the  
15 Comprehensive Reliability Assessment at the facility from 2008 through 2010, (2) the  
16 impact to the VY Station of requirements likely to be imposed by the federal government  
17 in light of the incidents at the similarly-designed Fukushima Daiichi nuclear power plant  
18 in 2011, and (3) certain statutory factors related to the application of Entergy Nuclear  
19 Vermont Yankee, LLC, and Entergy Nuclear Operations Inc. (collectively "Entergy") for  
20 a Certificate of Public Good.  
21  
22

1 Q5. Can you describe and explain the Comprehensive Reliability Assessment (“CRA”)?

2 A5. In June 2008, the General Assembly of the State of Vermont mandated “a thorough,  
3 independent, and public assessment of the reliability of the systems, structures, and  
4 components of the VY Station facility.” To satisfy this requirement, PSD contracted with  
5 Nuclear Safety Associates (“NSA”) to perform a reliability assessment of the VY Station,  
6 which is referred to as the CRA. After the CRA was completed in December 2008,  
7 information came to light indicating that the portions of the assessment related to  
8 underground piping systems carrying radionuclides had not been assessed, and PSD  
9 commissioned a supplemental reliability assessment (“SRA”) that was completed in April  
10 2010. I was hired by the PSD as a consultant to assist PSD in conducting the CRA and  
11 the SRA. Both of these assessments were conducted in consultation with the Public  
12 Oversight Panel (the “POP”), an independent body created by the General Assembly for  
13 just this purpose. The POP thoroughly reviewed the results of both the CRA and the  
14 SRA, and came to similar conclusions as contained in both assessments.

15  
16 Q6. What conclusions about the operations of the VY Station did PSD draw in connection  
17 with the CRA?

18 A6. As a result of the CRA, the SRA, and the POP’s review, there were many  
19 recommendations made to Entergy for how to effectively address operational and  
20 personnel issues that the CRA identified at the VY Station. The CRA identified many  
21 items that were then entered into the VY Station corrective action system for resolution.  
22 There were approximately 80 corrective action items from the CRA, and the SRA

1 identified approximately 12 corrective action items. The CRA recommendations  
2 included the areas of: Procedure Quality, Human Performance, Condenser Performance,  
3 Cooling Tower Inspections, Spare Main Transformer Planning, Equipment Reliability  
4 Program and Procedures, Change Management, Contractor Oversight, Corporate Fleet  
5 Managers Governance, Organization and Staffing, Continuous Improvement (Corrective  
6 Action Program, Self-Assessments, Operating Experience, Operations), Maintenance  
7 Action Plans, Work Control, and Design Change Process. The recommendations  
8 associated with the SRA were primarily focused on improvements related to early leak  
9 detection and monitoring of the VY Station Buried Pipe and Tank Inspection Program  
10 (“BPTIP”). Progress against these corrective action items was monitored by PSD with  
11 assistance from NSA personnel and me throughout much of 2010. Ongoing monitoring  
12 of these items since then has been performed by the Vermont State Nuclear Engineer as  
13 part of his normal monitoring responsibilities consistent with the Inspection  
14 Memorandum of Understanding as part of the broader Memorandum of Understanding  
15 between the PSD and Entergy, approved by this Board in Docket No. 6545.

16  
17 Q7. What is the status of Entergy’s work on the recommended augmented monitoring items  
18 identified in the CRA and the SRA?

19 A7. Entergy has continued to work to improve its operations pursuant to the  
20 recommendations of the CRA and the SRA, and the Vermont State Nuclear Engineer has  
21 monitored Entergy’s progress on these items. I am familiar with the operational issues at  
22 the VY Station based on my work in connection with the CRA. Based on my

1 professional experience, the biggest challenge faced by the VY Station in terms of  
2 reliable performance is the deteriorating condition of the aging main condenser at the  
3 plant. While Entergy has applied several temporary fixes to the main condenser tubes to  
4 account for the thinning and wear of the tubes, the main condenser tubes will need to be  
5 replaced as a long-term, permanent repair. This necessary replacement is well  
6 understood by Entergy and they continue to monitor the condition of the main condenser.  
7 Entergy has stated that it intends to continue with the interim short-term fixes of the  
8 condenser until it is issued a CPG by the Board. Replacement of the main condenser  
9 tubes has been estimated to cost between \$40 million to \$100 million and would require  
10 the plant to extend an outage for approximately three additional weeks. If the Board  
11 grants Entergy a CPG in this proceeding and Entergy were to continue to run the plant  
12 with only temporary fixes to the condenser, that may impact the long term reliability of  
13 the plant.

14  
15 Q8. Please describe the volume and storage of spent nuclear fuel on site at the VY Station.

16 A8. As of this testimony, there are approximately 67,000 metric tons of commercial spent  
17 nuclear fuel, which equates to around 150,000 spent fuel assemblies, in the United States.  
18 Sixty-two thousand of the spent fuel assemblies are stored in dry cask storage, while  
19 88,000 spent fuel assemblies are being stored in spent fuel pools.<sup>1</sup> In a dry storage  
20 system, a 1/2-inch to 5/8-inch thick stainless steel canister containing used fuel is placed  
21 inside a concrete structure (dry cask). At the VY Station, the canisters are oriented

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<sup>1</sup> Radwaste Solutions, September-October 2012, "Solving the Spent Fuel Dilemma," Nancy J. Zacha.

1 vertically inside the dry cask's reinforced concrete structure. The reinforced concrete  
2 structures are typically about 2.5 feet thick for vertical systems and provide shielding  
3 from radiation and protect the steel canister. The total weight of a typical dry storage  
4 system (canister and concrete structure) is between 160 and 180 tons.

5 There are 13 casks of spent nuclear fuel in dry cask storage at the VY Station.  
6 Each cask contains 68 fuel assemblies, for a total of 884 fuel assemblies. The existing  
7 dry cask storage pad at the VY Station can accommodate 36 casks, or 2,448 assemblies.  
8 Currently, there are an additional 2,507 fuel assemblies in the spent fuel pools at the VY  
9 Station. Entergy's Response to the Windham Regional Commission's Second Set of  
10 Information Requests. A.WRC:EN.2-12 (Oct. 3, 2012) (PSD-BH-03). The spent fuel  
11 pool at the VY Station can accommodate 3,353 assemblies; typically 120 assemblies are  
12 discharged from the reactor core into the spent fuel pool each outage.

13 From 2013 to 2032, it is projected that 1,928 bundles will be discharged from the  
14 reactor to the spent fuel pool, including the last 368 bundles in 2032 to achieve full core  
15 offload. Per the spent fuel loading schedule provided by Entergy (PSD-BH-03), all 36 of  
16 the casks at the VY Station's dry cask storage will be loaded on the existing cask pad by  
17 the end of 2024, containing 2,448 fuel assemblies. If Entergy does not or cannot expand  
18 its dry cask storage capability at the VY Station, according to Entergy's projections, by  
19 2032 there will be 2,871 fuel assemblies in the pool at the VY Station that will need to  
20 eventually be moved into dry storage casks at some location. Under Entergy's current  
21 Nuclear Regulatory Commission ("NRC") license, the only location where additional dry  
22 cask storage could be constructed is on site at the VY Station, and realistically there is

1 not an alternative plan for dry fuel storage of spent nuclear fuel (“SNF”) in this country at  
2 this time.

3  
4 Q9. What are some of the risks borne by Vermont in connection with long-term storage of  
5 spent nuclear fuel at the VY Station?

6 A9. While long-term storage of spent nuclear fuel poses radiological health and safety risks  
7 that are within the purview of the NRC, it also poses many other significant non-safety  
8 risks that are borne directly by the State of Vermont. For example, long-term storage of  
9 spent nuclear fuel restricts future use of the land on which the VY Station is currently  
10 located, as well as the surrounding areas. Long-term storage of spent nuclear fuel on site  
11 also imposes environmental, aesthetic, and economic burdens on Vermont long after the  
12 VY Station ceases operations, most notably the continued existence of the spent nuclear  
13 fuel storage pools and dry cask storage facilities and the concomitant local and state  
14 oversight and regulation that the existence of these facilities creates. At some unknown  
15 point in the future, the spent nuclear fuel currently stored at the VY Station will need to  
16 be transported away from the plant after very long term wet or dry storage. While the  
17 complexities involved with this transportation of spent nuclear fuel are not completely  
18 known, this transportation may require changes and improvements to rail lines, bridges,  
19 tunnels, and overpasses, near-site infrastructure assessments, transport route  
20 identification and approval, and emergency response training along the approved routes.  
21 Many of the costs associated with these infrastructure requirements would be borne by  
22 Vermont.

1

2 Q10. What is the status of the federal government's planned construction of a spent nuclear  
3 fuel repository at which spent nuclear fuel from commercial reactors like the VY Station  
4 will be permanently deposited?

5 A10. At present, the status of the proposed federal repository is highly uncertain. There does  
6 not currently exist a location to store spent nuclear fuel that has already been generated  
7 by the VY Station, or that would be generated at the plant if Entergy is issued a certificate  
8 of public good to operate the VY Station for 20 years beyond its original license term,  
9 other than on-site at the VY Station. There is also no timetable for the removal of spent  
10 nuclear fuel from the site.

11 The U.S. Government Accounting Office ("GAO") released a report on  
12 September 14, 2012, that lays out the challenges associated with storing spent nuclear  
13 fuel in densely packed fuel pools at nuclear plants across the country.<sup>2</sup> In the report, the  
14 GAO noted the uncertain status of the proposed federal repository for spent nuclear fuel  
15 at Yucca Mountain. In addition, the NRC has currently suspended issuance of any new  
16 operating licenses or license renewals for nuclear reactors pending its determination of  
17 how to address the storage of spent nuclear fuel.

18 The U.S. Department of Energy established the Blue Ribbon Commission on  
19 America's Nuclear Future ("BRC") on January 29, 2010, to conduct a comprehensive  
20 review of policies for managing the back end of the nuclear fuel cycle, including  
21 transportation of spent nuclear fuel and establishment of a new consolidated storage and

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<sup>2</sup> SNL Financial, September 14, 2012, "GAO finds challenges with spent fuel pool storage at nuclear plants," Kathleen Hart.

1        eventual disposal facility for spent nuclear fuel. The BRC issued several recommendations  
2        in its final report, included here as Exhibit PSD-BH-2. The BRC's recommendations  
3        relate to preparations for the eventual large-scale transport of spent nuclear fuel and high-  
4        level waste to consolidated storage and disposal facilities when such facilities become  
5        available.

6                The BRC report specifically recommended in the context of transportation  
7        concerns that the Department of Energy, in preparation for movement of SNF from  
8        shutdown reactor sites to consolidated storage, should develop procedures to enable state,  
9        regional, and local officials in areas affected by spent nuclear fuel shipments to train, prepare  
10       and otherwise deal with those shipments if and when they occur.

11  
12    Q11.    What are the non-safety impacts of continued operation of the VY Station with regards to  
13               spent nuclear fuel storage and final disposition?

14    A11.    As discussed above in A8, there is already a significant inventory of spent nuclear fuel in  
15               dry cask storage at the VY Station. Twenty more years of operation and  
16               decommissioning will generate twenty more years of spent nuclear fuel, and will require  
17               increased dry cask storage capacity on the VY Station site. Spent nuclear fuel from  
18               decommissioned nuclear plants is currently scheduled to be "first in the queue" when  
19               actual spent fuel shipments begin (whether to a centralized facility or to a repository) so  
20               that these sites can be completely cleaned up and repurposed for other uses. The impact  
21               of an additional 20 years of operation of the VY Station to Vermont is therefore twofold:  
22               (1) 20 additional years of operation generates 20 additional years' worth of spent nuclear

1 fuel that must be stored and eventually disposed of, and (2) 20 additional years of  
2 operation will move the VY Station further back in the queue for spent nuclear fuel  
3 disposal as other plants shutdown and decommission prior to March 2032.  
4

5 Q12. In light of the 2011 natural disaster and resulting crisis at the Fukushima Daiichi nuclear  
6 plant in Japan, what additional regulation might the VY Station be subject to that would  
7 have resulting environmental, economic, land use, and aesthetic impacts on the State of  
8 Vermont?

9 A12. The consequences of the incident at Fukushima were problematic not only because of the  
10 reactor units but significantly more severe because of the spent nuclear fuel pools. As a  
11 result of Fukushima and the issues with the spent fuel pools there, the NRC is considering  
12 additional requirements to ensure the safety and security of spent nuclear fuel storage at  
13 plants in the United States. It is expected that this review will result in additional and  
14 more stringent requirements for the method in which spent nuclear fuel is stored,  
15 requirements that will impact aesthetics and land use in Vermont. For example, the  
16 Union of Concerned Scientists, a leading science-based nonprofit, has identified  
17 modifications to the storage of spent nuclear fuel as a priority for the NRC to address,  
18 and have recommended to the NRC that it impose requirements that:

- 19 • Irradiated fuel should be transferred from spent fuel pools to dry casks as soon  
20 as possible after being out of reactor for five years;

- 1           • Irradiated fuel should be dispersed checkerboard-style within spent fuel pools
- 2           to maximize a plant's ability to respond to inventory/cooling loss events; and
- 3           that
- 4           • Dry casks should be stored and protected by some physical barrier that would
- 5           reduce the profile of the cask.

6           With the focus on long-term on site storage of spent nuclear fuel, it is fair to say that the  
7           NRC may require plant operators to implement a more robust design for the storage of  
8           spent nuclear fuel on-site. This most likely would require excavation and installation of  
9           barriers to provide additional protection to the spent nuclear fuel stored in the dry casks,  
10          and other potentially significant changes to the VY Station site related to the long-term  
11          storage of spent nuclear fuel.

12  
13   Q13.   Are there other impacts from Fukushima that Entergy may be required to implement that  
14          would result in environmental, economic, land use, and aesthetic impacts on the State of  
15          Vermont?

16   A13.   There are also likely some significant changes or modifications that Entergy will be  
17          required to make to the VY Station related to:

- 18           • Security and emergency back-up power systems;
- 19           • Systems and equipment to facilitate communications and assistance
- 20           between the VY Station and state and local emergency response
- 21           organizations;
- 22           • Staging areas for specialty equipment and resources; and

- Transportation routes, evacuation routes, means of evacuation, and accompanying logistics.

While these more stringent requirements would be borne by Entergy under NRC rules and therefore partially outside the scope of the Board's review here, they nonetheless have an effect on state planning, emergency resources and infrastructure as well.

Q14. What non-safety impacts would an additional 20 years of operation of the VY Station have on the disposal of low-level waste?

A14. Like the high-level spent nuclear fuel waste, extended operation will generate more low-level waste at the facility. Although the State of Vermont is a party to the Texas Compact, which gives waste generated from the VY Station access to the Texas Compact Disposal Facility, which is the only facility in the United States licensed in the last 30 years to dispose of Class A, B, and C low-level radioactive waste, uncertainty still exists related to the volume, cost, and availability of that storage. That uncertainty will increase the longer the VY Station operates for at least the following reasons:

- The Texas Compact Disposal Facility is licensed to dispose of low-level radioactive waste by the Texas Commission on Environmental Quality (TCEQ). The TCEQ, Texas' lead environmental agency, is responsible for ensuring that the waste and disposal site meets all appropriate environmental safeguards. The longer Entergy postpones sending its low-level waste to the Texas Compact facility, the greater the risk that the

1 facility, subject to state regulation by Texas, may be closed, full, or  
2 otherwise unable to accept waste from the VY Station.

- 3 • The Texas Low-Level Radioactive Waste Disposal Compact Commission  
4 has oversight of the volume of waste disposed of at the site in Andrews  
5 County, Texas. Vermont has two members and an alternate appointed by  
6 the Governor on the commission, and Texas has six members on the  
7 commission. The commission is authorized to enter into an agreement  
8 with any person, state, regional body, or group of states for the  
9 importation of low-level radioactive waste into the compact for  
10 management or disposal, provided that the agreement receives a majority  
11 vote of the commission. Although there are restrictions currently in place  
12 that limit the volumes of low-level waste imported from non-compact  
13 parties and preservation of Vermont's allocation of space in the facility,  
14 these could be changed by a majority vote of the Commission or action by  
15 the Texas Legislature. Accordingly, there is a risk that a lengthy delay in  
16 sending the VY Station's low-level radioactive waste to Texas could result  
17 in the facility being unavailable for VY Station waste because it has  
18 accepted waste from other states.

- 19 • The current operating and disposal license for the Texas facility is good  
20 until 2024 and thus will need to be reissued by the State of Texas at some  
21 point in the next 10-12 years. As with any license renewal that involves

1 radioactive waste, there is a risk that the license will not be renewed and  
2 thus the facility will not be available for waste from the VY Station.  
3

4 Q15. Based on your testimony above and your review of the testimony and evidence offered by  
5 Entergy, do you have an opinion regarding whether issuance of a Certificate of Public  
6 Good for Entergy to operate the VY Station for 20 years beyond its original license term  
7 would cause economic costs to the state and would have an undue adverse impact upon  
8 aesthetics, land use, and the natural environment?

9 A15. Continued operation of the VY Station by Entergy could have a significant undue adverse  
10 effect on aesthetics, land use, the natural environment, and could cause increased costs to  
11 the state, for the reasons I have discussed in my testimony. Entergy has failed to present  
12 evidence to demonstrate that it has adequately planned for its spent nuclear fuel  
13 obligations other than indefinite long term storage of spent nuclear fuel on site, and these  
14 obligations are likely to impose burdens and costs on Vermont, regardless of Entergy's  
15 responsibilities to the NRC, that would not promote the general good of the state.  
16

17 Q16. Does this conclude your testimony?

18 A16. Yes it does, at this time.